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Los Alamos and Pueblo Canyons Work Plan

Addendum

Surface Water and Alluvial Groundwater Sampling and Analysis Plan

Los Alamos
NATIONAL LABORATORY

Los Alamos NM 87545

Produced by the Canyons Focus Area

Authors: D. Katzman, M. Tardiff, and R. Kelly

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Acronyms and Abbreviations

ER	Environmental Restoration
LAPSAR	Los Alamos/Pueblo Canyons surface aggregate report
LIR	Laboratory implementation requirement
NFA	no further action
NMED	New Mexico Environment Department
PRS	potential release site
QP	quality procedure
SAP	sampling and analysis plan
SOP	standard operating procedure

1.0 INTRODUCTION

This sampling and analysis plan (SAP) addendum for Los Alamos and Pueblo Canyons describes revisions and updates to Section 7.3, Surface and Groundwater Sampling and Analysis Plan, of the work plan for Operable Unit (OU) 1049 (Los Alamos/Pueblo work plan) (LANL 1995, 50290). Previous investigations conducted under that document were considered insufficient by a technical team consisting of New Mexico Environment Department (NMED) and the Los Alamos National Laboratory (the Laboratory) Environmental Restoration (ER) Project personnel, largely because previous sampling evaluated subsections of the canyon system instead of capturing a comprehensive data set for the contaminant and hydrologic status throughout the Los Alamos Canyon watershed. This SAP addendum addresses that deficiency.

The delineation of watershed aggregates as part of the ER Project watershed approach was key in determining the adequacy of sample locations for this SAP addendum. The potential release site (PRS) aggregates consist of Upper Los Alamos Canyon, Middle Los Alamos Canyon, Lower Los Alamos Canyon, and Pueblo Canyon aggregates (see revised Figure 7-14, Los Alamos and Pueblo Canyons Surface Water, Alluvial Groundwater, and Spring Monitoring Locations). Investigations conducted under this SAP addendum will yield data to support a request for no further action (NFA) or corrective action decisions for those PRS aggregates. The conceptual model presented in the Los Alamos/Pueblo work plan was also updated to incorporate the potential effects of the Cerro Grande fire.

This SAP addendum also documents an ER Project programmatic decision to implement the intermediate and deep groundwater zones investigations contained in the Los Alamos/Pueblo work plan under the hydrogeologic work plan as necessary (LANL 1998, 59599). That decision provides the means to modify intermediate and deep groundwater investigation activities, as necessary, in response to an ongoing data review process.

This SAP addendum presents only the subsections of Section 7.3 that are changed. The revised text and tables presented in this document supersede the corresponding sections of the Los Alamos/Pueblo work plan.

Table 1.0-1
Crosswalk between Los Alamos/Pueblo Work Plan and SAP Addendum

Los Alamos/Pueblo Work Plan	SAP Addendum
Table 7-11, Description of Proposed Alluvial Wells	Table 7-11, Description and Rationale for Alluvial Groundwater and Surface Water Sampling Locations
Table 7-12, Description of Proposed Intermediate Perched Zone Wells	text; Table 7-11, Description and Rationale for Alluvial Groundwater and Surface Water Sampling Locations
Table 7-13, Summary of Surface Water and Groundwater Sample Collection Design	text
Table 7-15, Analyte List, Estimated Detection Limits, and Analytical Methods for Inorganic Constituents in Groundwater Samples	Table 7-16, Analytical Suites for Surface Water and Alluvial Groundwater Samples
Table 7-16, Analyte List, Estimated Quantitation Limits, and Analytical Methods for Radionuclide Constituents in Groundwater Samples	Table 7-16, Analytical Suites for Surface Water and Alluvial Groundwater Samples
Table 7-17, Analyte List and Analytical Methods for Additional Parameters in Groundwater Samples	Table 7-17, Laboratory Analytical Methods
Figure 7-14, Proposed Well Locations: western Los Alamos and Pueblo Canyons	Figure 7-14, Los Alamos and Pueblo Canyons Surface Water, Alluvial Groundwater, and Spring Monitoring Locations
Figure 7-15, Proposed Well Locations: central Los Alamos and Pueblo Canyons	Figure 7-14, Los Alamos and Pueblo Canyons Surface Water, Alluvial Groundwater, and Spring Monitoring Locations
Figure 7-16, Proposed Well Locations: eastern Los Alamos and Pueblo Canyons	Figure 7-14, Los Alamos and Pueblo Canyons Surface Water, Alluvial Groundwater, and Spring Monitoring Locations

2.0 REVISED TEXT

2.1 Revised Section 7.3.1, Objectives

The following text replaces text in the Los Alamos/Pueblo work plan:

Scope of the Investigation

The purpose of this SAP addendum is to (1) characterize contamination in surface water and alluvial groundwater and (2) support an assessment of human health and ecological risk posed by contamination in surface water and alluvial groundwater in the Los Alamos/Pueblo Canyons watershed. The characterization involves developing an understanding of the interaction between surface water and alluvial groundwater, and how contaminants identified in these waters relate to contaminant sources such as canyon floor sediment and PRSs. The assessment of these and other relevant data (e.g., sediment and biota data) for potential adverse effects on human health and the environment will be presented in the Los Alamos/Pueblo Canyons surface aggregate report (LAPSAR). Other relevant data collected by the Laboratory Water Quality Group (ESH-18) (e.g., storm water runoff, alluvial groundwater, and sediment) will be used to assess the fate and transport of contaminants and to support the development of an assessment of potential future impacts that may be caused by contaminant migration.

The proposed duration and frequency of sampling is one year with four rounds of sampling. Data collected during the four rounds of sampling will be placed in the context of relevant existing data (which are available from ESH-18), to evaluate long-term trends. Information such as temporal contaminant concentration trends will be used to assess recommendations for corrective actions and for long-term monitoring in the LAPSAR.

2.2 Revised Section 7.3.3, Surface Water and Alluvial Groundwater Sample Collection and Analysis

The following parts of Section 7.3.3 of the Los Alamos/Pueblo work plan are addressed with this SAP addendum: 7.3.3.1, Sampling Design; 7.3.3.1.1, Surface Water Sampling; and 7.3.3.1.2, Alluvial Water Sampling. The text for those sections is unchanged. The modifications occur in the tables and figures. The correspondence of the revised tables and figures to the original tables and figures is provided in Table 1.0-1.

The last three subsections of the Los Alamos/Pueblo work plan's Section 7.3.3 are no longer relevant to the scope of the Canyons Focus Area: Sections 7.3.3.1.3, Intermediate Perched Zone Groundwater Sampling; 7.3.3.1.4, Intermediate-Depth Borehole Characterization; and 7.3.3.1.5, Santa Fe Group (Main Aquifer) Sampling. Work discussed in those subsections is addressed in the hydrogeologic work plan (LANL 1998, 59599).

2.3 Revised Table 7-13, Summary of Surface Water and Groundwater Sample Collection Design

Table 7-13, Summary of Surface Water and Groundwater Sample Collection Design, is replaced with the following text:

Seasonal Coverage

Four rounds of sampling for surface water and alluvial groundwater will be conducted with the intent of providing comprehensive characterizations of the canyon system under different hydrologic conditions. This is important because characterization and risk estimation depends upon credible estimates of the range of contaminant concentrations. Contaminant concentration maxima and minima are often associated with the hydrologic state of the system, which can be related to the seasonal variability. The current conceptual model of seasonal influences upon the canyon system is that there are two high base-flow/high alluvial groundwater level periods during a year. These are associated with spring snowmelt and mid-summer monsoon rains. Low base-flow/low alluvial groundwater level periods typically occur in the intervening periods. Therefore, the objective is to collect four rounds of samples, relying on observations of surface water runoff and alluvial groundwater levels to trigger sampling of each of these hydrologic conditions. Numerous alluvial wells have been instrumented with water level transducers to collect a continuous record of head. These records will be used to identify the hydrologic conditions described above. The sampling rounds will be scheduled and initiated to capture these system conditions as identified by the hydrograph analysis and surface water observations. For each round of sampling, all locations will be sampled within a relatively short time period (one to two weeks) to get a comprehensive view of the watershed under relatively constant hydrologic conditions. Existing data from surveillance activities and previous ER sampling will be used to evaluate longer-term temporal trends.

Spatial Coverage

A field survey is ongoing to determine the presence and seasonal fluctuations of surface water. This information was used to design the spatial coverage of the sampling locations. Additionally, the alluvial groundwater wells that have been installed in Los Alamos and Pueblo canyons were evaluated for spatial

coverage of shallow alluvial water and their past performance as monitoring points. Selections of surface water and alluvial groundwater sampling locations were biased towards the presence of contamination and the spatial bracketing of contaminant sources. Table 7-11 (revised), Description of Monitoring Locations and Rationale for Alluvial Groundwater and Surface Water, provides the location description and rationale for each monitoring point. Figure 7-14 (revised), Los Alamos and Pueblo Canyons Surface Water, Alluvial Groundwater, and Spring Monitoring Locations, shows the locations of the monitoring points.

Another sampling design objective is to determine the nature, location, and chemical variability of surface water and alluvial groundwater quality and quantity. Historical data will be used where available to obtain the best possible understanding of temporal trends. Down-canyon extent of water occurrence and contamination will be estimated with data from this sampling campaign and then confirmed by institutional monitoring in the out years. A requirement for institutional monitoring is considered likely to evaluate potential changes to the system. Monitoring over a multiyear period will indicate whether the alluvial system is stable with fluctuations or on a change trajectory.

Nature, Sources, and Transport of Contamination

The analyses for this investigation are intended to serve two purposes. Contaminant analysis is designed to be sufficiently comprehensive to cover known or suspected contaminant releases into the canyon system. These data will indicate impacts to alluvial groundwater from legacy effluent releases. Measurements of natural water quality characteristics, such as temperature, pH, and conductivity are intended to provide additional data for understanding spatial and temporal variability throughout the system. Additionally, a significant amount of historical surface water and alluvial groundwater data exist within the ER Project and the Environmental Surveillance Program for Los Alamos and Pueblo Canyons. All the above-mentioned data will be used to develop a revised conceptual model that will be presented in the LAPSAR.

2.4 Revised Section 7.3.3.1, Sampling Design

The following text replaces text in the Los Alamos/Pueblo work plan:

This SAP addendum proposes using alluvial groundwater monitoring wells that have been installed in Los Alamos and Pueblo Canyons. The Los Alamos/Pueblo work plan proposed the installation of 16 alluvial observation wells and 9 intermediate-perched-zone wells to characterize contamination and spatial variability within the watershed. The current alluvial system coverage (which includes most of the wells originally proposed) does not differ from the original plan. The locations proposed in this addendum are a subset of the alluvial wells that are available for monitoring and are supported by the results of previous investigations in the canyons. The canyons investigations results are documented in the reach reports for Los Alamos (LANL 1998, 59667; LANL 1998, 65407), Pueblo (LANL 1998, 59159), and DP Canyons (LANL 1999, 63915). The intermediate-perched-zone investigations are now part of the hydrogeologic work plan (LANL 1998, 59599).

2.5 Revised Section 7.3.3.1.1, Surface Water Sampling

The following text replaces text in Section 7.3.3.1.1 of the Los Alamos/Pueblo work plan:

Surface Water Sampling

Surface water sampling will coincide with alluvial groundwater sampling in the canyons. Filtered and nonfiltered samples will be collected to support the assessment of direct exposures and solute fate and

transport. Analyses are provided in Table 7-16 (revised). Control of fieldwork and sample analysis is described in Section 7.3.3.1.3 of the Los Alamos/Pueblo work plan.

2.6 Revised Section 7.3.3.1.2, Alluvial Groundwater Sampling

The following text replaces text in Section 7.3.3.1.2 of the Los Alamos/Pueblo work plan:

Alluvial Groundwater Sampling

Alluvial groundwater will be sampled to evaluate the similarities and differences with surface water in the canyons. Surface water and alluvial groundwater data will be used together to assess changes in contaminant concentrations with distance from contaminant sources. These data can also be used to estimate the contaminant concentrations in the alluvial aquifer as potential sources of contaminants to deeper groundwater zones. Filtered and nonfiltered samples will be collected. Analyses are provided in the revised Table 7-16. Control of fieldwork and sample analysis is described in Section 2.5 (of the Los Alamos/Pueblo work plan).

2.7 Revised Section 7.3.3.2, Sampling Methods, and Section 7.3.3.3, Analytical Methods

This following text supersedes Section 7.3.3.2, Sampling Methods, and Section 7.3.3.3, Analytical Methods, in the Los Alamos/Pueblo work plan:

Table 7-16 (revised) lists measurements that will be made for each alluvial groundwater and surface water sample. Table 7-17 (revised) of this SAP addendum lists laboratory analytical methods that will be used for these samples. Coordination with the analytical laboratories will ensure that laboratory method detection limits and reporting limits provide data that are adequate for use in human health and ecological risk assessments.

All procedures for sampling and field measurements are controlled by the quality management plan for the Laboratory Environmental Restoration Project, Quality Management Plan (LANL 2001, 69864). All fieldwork will be performed in accordance with relevant QPs, SOPs, and LIRs.

3.0 REVISED TABLES

The following tables replace tables in the Los Alamos/Pueblo work plan (LANL 1995, 50290). Table numbers have not been changed to reflect tables (Tables 7-12 and 7-13 from the Los Alamos/Pueblo work plan) that have been deleted for this SAP addendum.Table1.0-1 of this SAP addendum lists the revised text and tables that supercede the corresponding sections of the Los Alamos/Pueblo work plan (LANL 1995, 50290).

3.1 Revised Table 7-11

The following table replaces Table 7-11 in the Los Alamos/Pueblo work plan.

Table 7-11
Description and Rationale
for Alluvial Groundwater, Surface Water, and Spring Sampling Locations

Los Alamos Canyon alluvial groundwater wells and springs	
LAO-B	Provides baseline alluvial groundwater quality for groundwater moving onto the Laboratory from the upper Los Alamos watershed.
LAO-C	Provides secondary baseline data with respect to Laboratory contaminants, but the well is located below some paved areas and areas that are salted periodically during winter. Also situated to provide baseline to assess potential impact from TA-1 hill slope PRSs.
LAO-0.3	Characterizes potential impact of TA-1 PRSs, and situated up canyon of TA-41 PRSs.
LAO-0.7	Characterizes potential impact of TA-41 PRSs, and provides baseline for characterizing potential impact of TA-2 PRSs.
LAO-1	Characterizes potential impact from TA-2 PRSs.
LAO-1.6g	Characterizes potential impact to Los Alamos Canyon from TA-53 outfall.
LAUZ-1	Situated at bottom of PRS 21-011(k). Monitors the legacy effects of the 21-011(k) outfall.
DP Spring	Monitors downstream water quality associated with impacts from PRS 21-011(k) and associated contaminated sediments distributed along DP Canyon.
LAO-2	Monitors alluvial groundwater quality at downstream location in DP Canyon immediately above confluence with Los Alamos Canyon.
LAO-3a	Monitors immediate effects of mixing of Los Alamos and DP Canyon alluvial groundwater.
LAO-4	Monitors downstream trends associated with contaminant transport and continued interaction with contaminated sediments in Los Alamos Canyon.
LAO-4.5	Monitors downstream trends associated with contaminant transport and continued interaction with contaminated sediments in Los Alamos Canyon.
LAO-6	Monitors downstream trends associated with contaminant transport and continued interaction with contaminated sediments in Los Alamos Canyon.
Basalt Spring	Characterizes water that discharges into lower Los Alamos Canyon derived primarily from the Pueblo Canyon wastewater treatment plant.
LLAO-1	Monitors spatial variability of waters sourced from Los Alamos and Pueblo Canyons.
LLAO-5	Monitors spatial variability of waters sourced from Los Alamos and Pueblo Canyons.
Los Alamos Canyon surface water	
LA Reservoir	Provides baseline surface water quality, which is especially important due to potential geochemical changes resulting from the Cerro Grande fire.
LA Canyon near LAO-C	LA Canyon above PRSs or contaminated sediment; thus provides baseline on Laboratory.
LA Canyon near LAO-1	Located below TA-2 to measure potential impact from PRSs and contamination in canyon floor sediments.
"LA Canyon at Upper GS"	Located just above DP Canyon confluence, last monitoring site to characterize water quality prior to mixing with DP Canyon influence.
Upper Reach DP-1	Characterizes Townsite runoff impact and provides baseline for DP Tank Farm
Lower Reach DP-1	Located below the DP Tank Farm seeps; bounds canyon segment with identified hydrocarbon seeps.
DPS-1	Located within the area potentially affected by PRS 21-011(k).
DPS-4	Located at mouth of DP Canyon immediately above confluence with Los Alamos Canyon. Characterizes cumulative impact of all DP Canyon reaches.

Table 7-11 (continued)

Los Alamos Canyon surface water	
Los Alamos at State Road 4	Laboratory boundary; characterizes impact from contaminated sediments in reaches LA-2 and LA-3
SW near LLAO-1	Characterizes potential impacts of contaminated sediments in reach LA-4W and establishes baseline for upper end of lower Los Alamos Canyon.
Los Alamos at Rio Grande	Last surface water site in Los Alamos Canyon before confluence with Rio Grande
Pueblo Canyon alluvial groundwater wells	
PAO-1	Provides characterization of minor Laboratory contaminant sources upgradient of Acid Canyon confluence.
PAO-2	Located in Pueblo Canyon just below Acid Canyon confluence. Characterizes influence of surface water runoff originating in Acid Canyon and the South Fork of Acid Canyon.
PAO-3	Located in Reach P-2E. Characterizes potential impact to alluvial groundwater from contaminated sediments in Reach P-1 and P-2 and minor TA-0 PRSs located along this section of Pueblo Canyon.
PAO-4	Located in Reach P-3E. Characterizes potential impact to alluvial groundwater from contaminated sediments in Reach P-2 and P-3 and the County wastewater treatment plant.
APCO-1	Located in Reach P-4E. Characterizes potential impact to alluvial groundwater from contaminated sediments in Reach P-4.
Pueblo Canyon surface water	
Main Acid Canyon above South Fork confluence	Located just above the 0-030(g) confluence. Characterizes water quality associated with town site runoff.
Upper South Fork Plunge Pool	Characterizes surface water quality in South Fork up-canyon of areas with highest levels of sediment contamination.
South Fork Plunge Pool just above Acid Canyon Confluence	Characterizes surface water quality in South Fork down-canyon of areas with highest levels of contaminated sediment.
Pueblo 1R (in P-1 Far West)	Located in Pueblo Canyon just above Acid Canyon confluence. Characterizes water quality associated with town site runoff.
Pueblo 2	Located in Reach P-2West. Characterizes water quality associated with contaminated sediments in Pueblo Canyon and the impact of surface water runoff from Acid Canyon.
Pueblo 3	Located in Reach P-3E. Characterizes water quality resulting from interaction of surface water runoff with contaminated sediments in Reaches P-2 and P-3W.
Pueblo at State Road 502	Located at east end of Reach P-4E. Last monitoring point in Pueblo Canyon above confluence with Los Alamos Canyon. Characterizes cumulative impact to surface water runoff in Pueblo Canyon.

3.2 Revised Table 7-16

The following table replaces Table 7-16 in the Los Alamos/Pueblo work plan.

Table 7-16
Analytical Suites for Surface Water and Alluvial Groundwater Samples

Field-measured parameters		
Dissolved oxygen pH	Temperature	
Specific conductance	Turbidity	
Metals (filtered and nonfiltered)		
Aluminum	Copper	Silica
Antimony	Iron	Silver
Arsenic	Lead	Sodium
Barium	Magnesium	Thallium
Beryllium	Manganese	Uranium
Boron	Mercury	Vanadium
Calcium	Molybdenum	Zinc
Chromium	Nickel	
Cobalt	Potassium	
Other inorganics (filtered)		
Bromide	Perchlorate	Total alkalinity
Chloride	Phosphate	
Fluoride	Sulfate	
Organics (nonfiltered)		
Ammonium	Nitrate	total organic carbon
Cyanide (amenable to chlorination) (nonfiltered)	Nitrite	Total petroleum hydrocarbons-diesel range organics
Dissolved organic carbon (filtered)	Pesticides/PCBs	Volatile organic compounds
Humic acid	Semivolatile organic compounds	
Radionuclides (filtered and nonfiltered)		
Americium-241 by alpha spectroscopy	Plutonium-239,240	Uranium-234
Amercium-241 by gamma spectroscopy	Ruthenium-106	Uranium-235
Cesium-137	Sodium-22	Uranium-235 by gamma spectroscopy
Cobalt-60	Strontium-90	Uranium-238
Europium-152	Technicium-99	
Plutonium-238	Tritium	

Note: Filtered samples will be passed through a 0.45-µm filter.

3.3 Revised Table 7-17

The following table replaces Table 7-17 in the Los Alamos/Pueblo work plan.

Table 7-17
Laboratory Analytical Methods

Analyte	Laboratory Analysis Method[a]
Field measured parameters	n/a
Anions	EPA300.1
Alkalinity (total)	EPA310.1
Perchlorate	EPA314.0
Ammonia (as N)	EPA350.3
Organic carbon and humic substances	EPA415.1
Cyanide (amenable to chlorination)	EPA335
Nitrate	EPA300.1
Nitrite	EPA300.1
Phosphate (total)	EPA300.1
Metals	SW6010/SW6020/SW7470
Diesel range organics	SW8015M
Pesticides	SW8081
PCBs	SW8082
VOCs	SW8260
SVOCs	SW8270
PAHs	SW8310
Americium-241	Alpha spec
Strontium-90	Beta proportional counting
Technetium-99	Beta proportional counting
Tritium	EPA900
Cesium-134	Gamma spec
Cesium-137	Gamma spec
Cobalt-60	Gamma spec
Europium-152	Gamma spec
Ruthenium-106	Gamma spec
Sodium-22	Gamma spec
Plutonium-238	IsoPu
Plutonium-239	IsoPu
Uranium-234	IsoU
Uranium-235	IsoU
Uranium-238	IsoU

[a]n/a=Not applicable.

4.0 ADDITIONAL REFERENCES FOR REVISED CHAPTER 7

The following references are additions to the reference list provided in Chapter 7 of the OU 1049 work plan (LANL 1995, 50290).

Environmental Restoration Project, August 1999, "Evaluation of Sediment and Alluvial Groundwater in DP Canyon," Los Alamos National Laboratory Report LA-UR-99-4238, Los Alamos, New Mexico. (Environmental Restoration Project 1999, 63915)

Environmental Restoration Project, April 2001. "Quality Management Plan for the Los Alamos National Laboratory Environmental Restoration Project," Rev. 1, Los Alamos, New Mexico. (Environmental Restoration Project 2001, 69864)

LANL (Los Alamos National Laboratory), November 1995. "Task/Site Work Plan for Operable Unit 1049: Los Alamos Canyon and Pueblo Canyon," Los Alamos National Laboratory Report LA-UR-95-2053, Los Alamos, New Mexico. (LANL 1995, 50290)

LANL (Los Alamos National Laboratory), May 1998. "Hydrogeologic Workplan," Los Alamos, New Mexico. (LANL 1998, 59599)

Reneau S., R. Ryti, M. Tardiff, and J. Linn, September 1998. "Evaluation of Sediment Contamination in Lower Los Alamos Canyon, Reaches LA-4 and LA-5," Los Alamos National Laboratory Report LA-UR-98-3975, Los Alamos, New Mexico. (Reneau et al. 1998, 59667)

Reneau, S., R., Ryti, M. Tardiff, and J. Linn, September 1998. "Evaluation of Sediment Contamination in Pueblo Canyon: Reaches P-1, P-2, P-3, and P-4," Los Alamos National Laboratory Report LA-UR-98-3324, Los Alamos, New Mexico. (Reneau et al. 1998, 59159)

Reneau, S., R. Ryti, M. Tardiff, and J. Linn, September 1998. "Evaluation of Sediment Contamination in Upper Los Alamos Canyon, Reaches LA-1, LA-2 and LA-3," Los Alamos National Laboratory Report LA-UR-98-3974, Los Alamos, New Mexico. (Reneau et al. 1998, 65407)

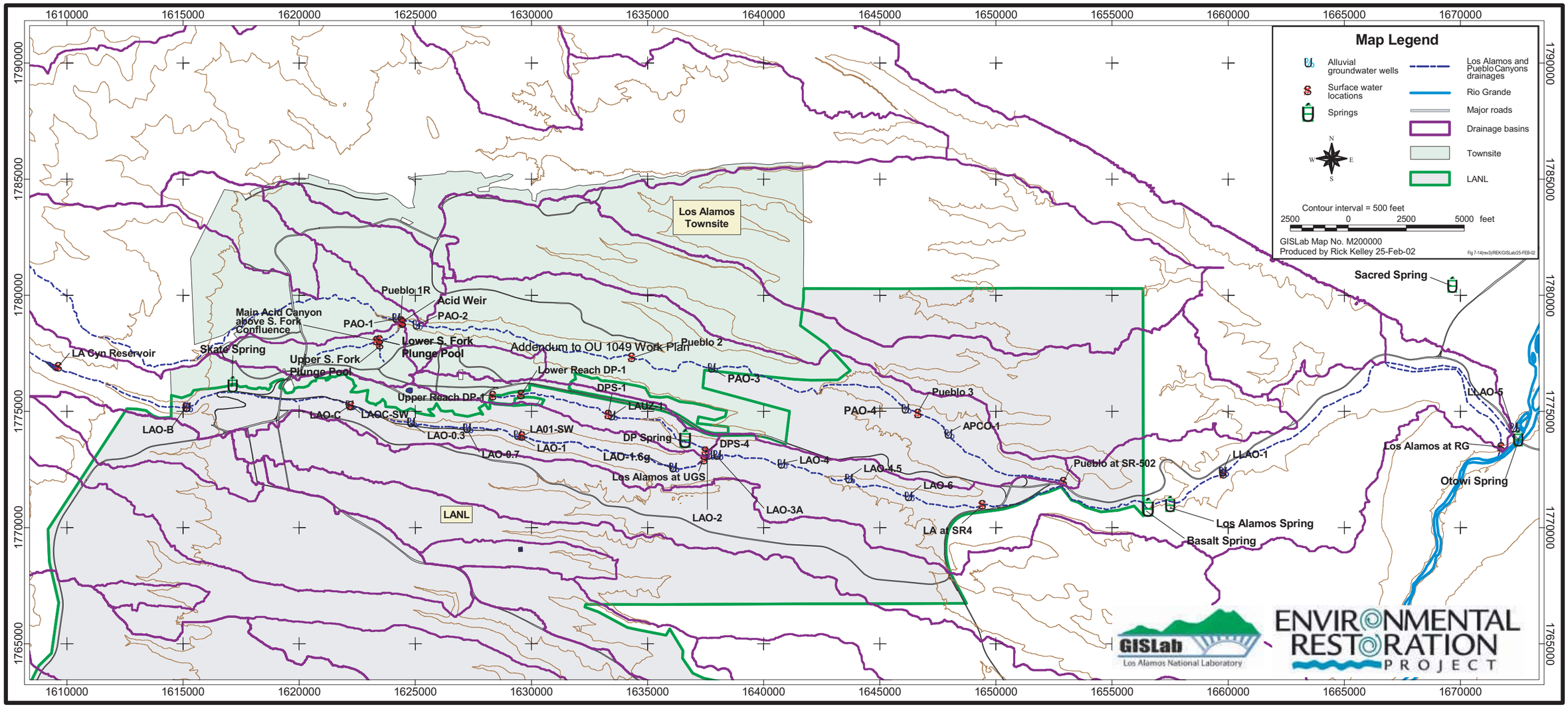

Figure 7-14. Los Alamos and Pueblo Canyons surface water, alluvial groundwater, and spring monitoring locations